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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/590,464	06/09/2000	Randhir P. S. Thakur	AGX-39	1778

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EXAMINER

MARKHAM, WESLEY D

ART UNIT	PAPER NUMBER
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1762

DATE MAILED: 10/06/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application N .

09/590,464

Applicant(s)

THAKUR, RANDHIR P. S.

Examiner

Wesley D Markham

Art Unit

1762

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 20-22, 24, 25, 30, 50-55, 57, 58, 61-68, 70-73 and 75-79 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 20-22, 24, 25, 30, 50-55, 57, 58, 61-68, 70-73 and 75-79 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application as paper #14 on 7/23/2003 (with a certificate of mailing dated 7/21/2003) after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office Action (i.e., paper #11, mailed on 12/18/2002) has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7/23/03 has been entered.

Response to Amendment

2. Acknowledgement is made of applicant's amendment C, filed as paper #15 on 7/23/2003, in which Claims 20, 50 – 52, and 70 were amended, Claims 29, 56, 59, 60, 69 and 74 were canceled, and Claims 75 – 79 were added. Claims 20 – 22, 24, 25, 30, 50 – 55, 57, 58, 61 – 68, 70 – 73, and 75 – 79 are currently pending in U.S. Application Serial No. 09/590,464, and an Office Action on the merits follows.

Drawings

3. This application has been filed with informal drawings which are acceptable for examination purposes only. Formal drawings will be required when the application is allowed.

Claim Objections

4. The objection to Claim 70, set forth in paragraph 3 of the previous Office Action (i.e., the final Office Action, paper #11, mailed on 12/18/2002), is withdrawn in light of applicant's amendment C in which a minor typographical error in the claim was corrected.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. The rejection of Claims 61 and 62 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, set forth in paragraphs 5 and 6 of the previous Office Action, is withdrawn. Specifically, on page 8 of the **REMARKS** filed on 7/23/2003, the applicant states that the terms "dielectric material" and "conductive material" are described with examples in the specification and are familiar to those skilled in the art, and therefore meet all the requirements of 35 U.S.C. 112. After carefully reviewing the specification, the examiner notes that several examples of "conductive layers" and "dielectric layers" are provided by the applicant in the specification as originally filed (page 16, lines 1 – 7), and as such, one of ordinary skill in the art would be reasonably apprised of the scope of Claims 61 and 62.

7. Claims 20 – 22, 24, 25, 30, 50 – 55, 57, 58, 61 – 68, 70 – 73, and 75 – 79 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
8. Specifically, amended independent Claims 20 (from which Claims 21, 22, 24, 25, and 30 depend), 50, 51, 52 (from which Claims 53 – 55, 57, 58, 61 – 68, and 70 – 73 depend), and new independent Claim 75 (from which Claims 76 – 79 depend) all recite the term “thermal light energy” in conjunction with the claimed annealing step (e.g., “by exposing the solid layer to thermal light energy”) and/or deposition step (e.g., “exposing said precursor fluid to thermal light energy ...causing said precursor fluid to convert into a solid layer on said substrate”). After carefully reviewing the specification as originally filed, the examiner notes that the term “thermal light energy” is not described or defined. In fact, it does not appear to the examiner that the term “thermal light energy” was present in the application as originally filed. Further, the term “thermal light energy” does not appear to have an art-recognized definition. Therefore, it is unclear what types of “light energy” the applicant intends to include in the claims by using the term “thermal light energy”, and what types of “light energy” the applicant intends to exclude (e.g., what types of “light energy” are not “thermal light energy”?). For this reason, the scope of the applicant’s claims is unclear, and the claims are vague and indefinite under 35 U.S.C. 112, second paragraph.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 20 – 22, 24, 25, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishizawa et al. (USPN 5,443,033) in view of Dautartas et al. (USPN 6,124,158), and in further view of Moore et al. (USPN 5,710,407).
11. Regarding independent Claim 20 (from which Claims 21, 22, 24, 25, and 30 depend), Nishizawa et al. teach a method of forming layers in electronic devices, the method comprising providing a reaction chamber (Figure 1, reference number "1", and Col.4, lines 21 – 22), placing a semiconductor wafer in the reaction chamber (Figure 1, reference number "12", and Col.4, lines 54 – 56), heating the semiconductor wafer with a thermal heating device placed adjacent to the wafer to a temperature of at least about 300° C (Figure 1, reference number "10", and Col.4, lines 36 – 39 and 60 – 61), pulsing a precursor fluid into the reaction chamber to form a solid layer on the semiconductor wafer (Col.4, lines 52 – 69 and Col.5, lines 1 – 19), exposing the solid layer to light energy in the reaction chamber "continuously or intermittently during the process of growth", wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid (Col.4, lines 65 – 66, Col.5, lines 3 – 8, Col.6, lines 22 –

28). Specifically, Nishizawa et al. teach that the substrate with the growing epitaxial layer is irradiated with UV irradiation continuously or intermittently during the process of growth (Col.6, lines 22 – 28). Since the “process of growth” of Nishizawa et al. includes both the time periods in which a precursor gas is pulsed and the time period in which the chamber is exhausted between pulses of precursor gases (Col.4, lines 52 – 58, and Col.5, lines 1 – 7), it is clear that Nishizawa et al. contemplate exposing the substrate with the growing solid layer to UV irradiation during the time period in between pulses of the precursor fluid. It would have been obvious to one of ordinary skill in the art to pulse (i.e., intermittently irradiate) the UV light any number of times throughout the process of growth, including during the multiple precursor pulsing and evacuation steps of the process of Nishizawa et al. (i.e., to “anneal” the solid layer multiple times after certain pulses of the precursor fluid by exposing the solid layer to UV light energy), with the reasonable expectation of (1) success, as Nishizawa et al. teach that the growing epitaxial layer (i.e., the solid layer) can be irradiated with UV irradiation continuously or intermittently during the process of growth, and (2) obtaining the benefits of pulsing the UV light energy as opposed to continuously irradiating the UV light energy, such as reducing the amount of energy (and therefore the cost) needed to carry out the deposition process. Since UV radiation inherently gives off / provides some amount of thermal energy, the examiner has reasonably interpreted the UV light of Nishizawa et al. to be a kind of “thermal light energy”, as required by the applicant’s claims. Nishizawa et al. do not explicitly teach that, between each pulse of precursor fluid, the reaction chamber is purged by

flowing an inert gas through the reaction chamber in order to substantially remove any precursor fluid not converted into a solid. However, Nishizawa et al. do teach that between the pulses of precursor fluid, the chamber is evacuated (Col.4, lines 60 – 68). Dautartas et al. teach a similar atomic layer epitaxial process for depositing a layer in a semiconductor device (Abstract). Further, Dautartas et al. teach that it was known in the art at the time of the applicant's invention to purge a reaction chamber with an inert gas between pulses of precursor gases to remove residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate (Col.3, lines 23 – 67, and Col.4, line 1). Therefore, it would have been obvious to one of ordinary skill in the art to purge the reaction chamber of Nishizawa et al. with an inert gas between the precursor gas pulses (i.e., instead of simply evacuating the chamber between pulses as taught by Nishizawa et al.) in order to substantially remove any remaining vaporous precursor material from the chamber with the reasonable expectation of (1) success, as Dautartas et al. teach that such a process is possible and known in the art, and (2) obtaining the benefits of the inert gas purging step, such as removing residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate. Dautartas et al. teach that this purging technique eliminates gas phase reactions and gas phase powder formation, both of which detract from the quality of the film (Col.3, lines 66 – 67, and Col.4, line 1). In addition, Nishizawa et al. do not explicitly teach that the reaction chamber is a "cold wall" chamber. Specifically, Nishizawa et al. are silent as to whether the chamber is a "hot wall"

chamber or a "cold wall" chamber. However, the reaction chamber of Nishizawa et al. does not appear to be directly heated, as the substrate temperature is maintained by the heater "10" placed adjacent to the substrate (see Figure 1 and Col.4, lines 60 – 61). Moore et al. teach a similar deposition method and apparatus to that of Nishizawa et al. (i.e., a deposition method and apparatus in which both a heating element placed adjacent to the substrate and radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25). Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of the combination of Nishizawa et al. and Dautartas et al. with the reasonable expectation of successfully and advantageously preventing unwanted film deposition on the reaction chamber walls, thereby preventing

unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

12. The combination of Nishizawa et al., Dautartas et al., and Moore et al. also teaches all the limitations of Claims 21, 22, 24, 25, and 30 as set forth above in paragraph 11 and below, including a method wherein:

- Claim 21 – The precursor fluid comprises a gas (Col.4, line 61 of Nishizawa et al.).
- Claim 22 – The thermal heating device comprises an electrical resistance heater (Col.4, lines 33 – 39 of Nishizawa et al.).
- Claims 24 – 25 and 30 – The reaction chamber is maintained at a pressure of less than about 760 torr, particularly less than about 3 torr, particularly between about 10^{-2} torr and 10^{-7} torr, when pulsing the precursor fluid into the reaction chamber. Specifically, Nishizawa et al. teach a pressure of 0.1 Pascal, which correlates to about 7.5×10^{-4} torr (i.e., a pressure within the applicant's claimed range) (Col.4, lines 64 – 65).

13. Claims 20, 21, 24, 25, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Utsumi et al. (USPN 5,495,822) in view of Dautartas et al. (USPN 6,124,158), and in further view of Moore et al. (USPN 5,710,407).

14. Regarding independent Claim 20, Utsumi et al. teach a process for forming layers in semiconductor (i.e., electronic) devices comprising providing a reaction chamber, placing a semiconductor wafer in the reaction chamber, heating the semiconductor

wafer with a thermal heating device placed adjacent to the wafer to a temperature of at least about 300° C (Figure 3, Col.5, Col.6, line 38, and Col.7, line 29), pulsing a precursor fluid into the reaction chamber, the precursor fluid forming a solid layer on the semiconductor wafer (Figure 6 and Col.6, lines 1 – 30), and thereafter exposing the solid layer to light energy in the reaction chamber, wherein the solid layer is exposed to the light energy in between each pulse of the precursor fluid (i.e., the solid layer is annealed multiple times after certain pulses – i.e., every pulse – of the precursor fluid by exposure to light energy) (Figure 6). Additionally, the light source of Utsumi et al. is a high-intensity light source having high-intensities in the X-ray to UV region of the spectrum (Col.3, lines 50 – 57, and Col.5, lines 39 – 45). This kind of light source would have inherently produced some thermal energy (i.e., heat), and therefore the examiner has reasonably interpreted the light energy of Utsumi et al. to be “thermal light energy”, as required by the applicant’s claims. Utsumi et al. do not explicitly teach that, between each pulse of precursor fluid, the reaction chamber is purged by flowing an inert gas through the reaction chamber in order to substantially remove any precursor fluid not converted into a solid. However, Utsumi et al. do teach that while the light energy is supplied, the flow of precursor gas is stopped (Col.5, lines 39 – 45). This is done to prevent the radiation from exciting the precursor gas to produce a vapor phase decomposed species that would deposit on the substrate (Col.5, lines 46 – 49). Dautartas et al. teach a similar atomic layer epitaxial process for depositing a layer in a semiconductor device (Abstract). Further, Dautartas et al. teach that it was known in the art at the time of the

applicant's invention to purge a reaction chamber with an inert gas between pulses of precursor gases to remove residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate (Col.3, lines 23 – 67, and Col.4, line 1). Therefore, it would have been obvious to one of ordinary skill in the art to purge the reaction chamber of Utsumi et al. with an inert gas between the precursor gas pulses in order to substantially remove any remaining vaporous precursor material from the chamber with the reasonable expectation of (1) success, as Dautartas et al. teach that such a process is possible and known in the art, and (2) obtaining the benefits of the inert gas purging step, such as removing residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate (i.e., preventing unwanted vapor phase decomposed species, as desired by Utsumi et al.). In addition, Utsumi et al. do not explicitly teach that the reaction chamber is a "cold wall" chamber. Specifically, Utsumi et al. are silent as to whether the chamber is a "hot wall" chamber or a "cold wall" chamber. However, the reaction chamber of Utsumi et al. does not appear to be directly heated, as the substrate temperature is maintained by the heater "4" placed adjacent to the substrate (see Figure 3 and Col.5, lines 19 – 20). Moore et al. teach a similar deposition method and apparatus to that of Utsumi et al. (i.e., a deposition method and apparatus in which both a heating element placed adjacent to the substrate and radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such

a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25). Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of the combination of Utsumi et al. and Dautartas et al. with the reasonable expectation of successfully and advantageously preventing unwanted film deposition on the reaction chamber walls, thereby preventing unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

15. The combination of Utsumi et al., Dautartas et al., and Moore et al. also teaches all the limitations of Claims 21, 24, 25, and 30 as set forth above in paragraph 14 and below, including a method wherein:

- Claim 21 – The precursor fluid comprises a gas (Abstract of Utsumi et al.).
- Claim 24 – The reaction chamber is maintained at a pressure of less than about 760 torr (Col.6, line 19 of Utsumi et al.).

- Claim 25 - The reaction chamber is maintained at a pressure of less than about 3 torr (Col.6, line 19 of Utsumi et al.).
- Claim 30 - The reaction chamber is maintained at a pressure of from about 10^{-2} torr to about 10^{-7} torr (Col.6, line 19 of Utsumi et al.).

16. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Utsumi et al. (USPN 5,495,822) in view of Dautartas et al. (USPN 6,124,158), in further view of Moore et al. (USPN 5,710,407), and in further view of Murota et al. (USPN 5,705,224).

17. The combination of Utsumi et al., Dautartas et al., and Moore et al. teaches all the limitations of Claim 22 as set forth above in paragraph 14, except for a process wherein the thermal heating device comprises an electrical resistance heater. Utsumi et al. teach a thermal heating device in general placed adjacent to the substrate (Figure 3, reference number "4"). Murota et al. teach a similar ALD process in which the substrate is successfully heated through the use of an electrical resistance heater placed adjacent to the substrate (Col.4, lines 24 – 37, and Figure 1, reference numbers 11 – 12). It would have been obvious to one of ordinary skill in the art to heat the substrate of Utsumi et al. with the electrical resistance heater of Murota et al. with the reasonable expectation of successfully heating the substrate as desired by Utsumi et al. through the use of an electrical resistance heater (i.e., selecting a well-known species (i.e., an electrical resistance heater) out of the broader genus of thermal heating devices taught by Utsumi et al.).

18. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Murota et al. (USPN 5,705,224) and Nishizawa et al. (USPN 5,443,033).
19. Regarding Claim 51, DiMeo, Jr. et al. teach a process for forming layers in electronic devices (Col.1, line 14), the process comprising the steps of providing a reaction chamber, placing a semiconductor wafer substrate in the reaction chamber (Abstract and Col.11, lines 53 – 55), heating the substrate to a desired temperature during the deposition process (Col.10, lines 50 – 52), pulsing a precursor fluid into the reaction chamber, the precursor fluid forming a solid layer on the substrate, wherein the solid layer comprises a material selected from the group consisting of zirconium oxide, aluminum oxide, barium strontium titanate (BST), and a silicate (Abstract, Figs. 1 – 3, Col.7, lines 19 – 38, Col.9, lines 21 – 67, and Col.10, lines 1 – 40), and utilizing UV light energy as an additional activation means beyond thermal activation means in the process (Cols. 8 – 10, especially Col.10, lines 53 – 64), wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid by purging the reaction chamber with an inert gas after each pulse of precursor fluid (Figs. 2 – 3 and Cols. 9 – 10). DiMeo, Jr. et al. do not explicitly teach that the semiconductor wafer is heated with a thermal heating device placed adjacent to the wafer. However, DiMeo, Jr. et al. do teach that the substrate is heated to a temperature of from about 400 to 800° C during the deposition but are silent as to how the substrate is heated (Col.10, lines 50 – 52).

Murota et al. teach a similar photo-induced ALD process in which the substrate is successfully heated through the use of an electrical resistance heater placed adjacent to the substrate (Col.4, lines 24 – 37, and Figure 1, reference numbers 11 – 12). It would have been obvious to one of ordinary skill in the art to heat the substrate of DiMeo, Jr. et al. with the electrical resistance heater of Murota et al. with the reasonable expectation of successfully heating the substrate as desired by DiMeo, Jr. et al. and taught by Murota et al. through the use of an electrical resistance heater (i.e., selecting a well-known means of successfully heating a substrate out of the broader genus of heating a substrate in general as taught by DiMeo, Jr. et al.) In addition, DiMeo Jr. et al. do not explicitly teach that the solid layer is annealed multiple times by exposure to thermal light energy after certain pulses of the precursor fluid. Specifically, DiMeo, Jr. et al. are silent as to the specific timing of the UV light exposure, except to say that the UV light energy is used as an additional activation means beyond thermal activation means in the process.

Nishizawa et al. teach a similar process (i.e., a process in which both thermal and UV light energy are utilized during a pulsed-precursor deposition) and teach that the UV-irradiation can be done either continuously or intermittently during the process of growth (Col.6, lines 22 – 28). By performing such a step, the deposition temperature can advantageously be reduced (Col.5, lines 3 – 6). Since the “process of growth” of Nishizawa et al. includes both the time periods in which a precursor gas is pulsed and the time period in which the chamber is exhausted between pulses of precursor gases (Col.4, lines 52 – 58, and Col.5, lines 1 – 7), it is clear that Nishizawa et al.

contemplate exposing the substrate with the growing solid layer to UV irradiation during the time period in between pulses of the precursor fluid, as well as during the pulses of precursor fluid. It would have been obvious to one of ordinary skill in the art to pulse (i.e., intermittently irradiate) the UV light of DiMeo, Jr. et al. any number of times throughout the process of growth of DiMeo, Jr. et al., including during the multiple precursor pulsing and inert gas purging steps of the process of DiMeo, Jr. et al. (i.e., to “anneal” the solid layer multiple times after certain pulses of the precursor fluid by exposing the solid layer to UV light energy), with the reasonable expectation of successfully and advantageously “activating” the deposition process of DiMeo, Jr. et al. using UV light and reducing the deposition temperature, as well as obtaining the benefits of pulsing the UV light (e.g., as opposed to continuously irradiating the UV light), such as reducing the total amount of energy (and therefore the cost) needed to carry out the deposition process. Since UV radiation inherently gives off / provides some amount of thermal energy, the examiner has reasonably interpreted the UV light of DiMeo, Jr. et al. and Nishizawa et al. to be a kind of “thermal light energy”, as required by the applicant’s claims.

20. Claim 50 is rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Murota et al. (USPN 5,705,224) and Nishizawa et al. (USPN 5,443,033), and in further view of Gates et al. (USPN 6,203,613 B1).
21. The combination of DiMeo, Jr. et al., Murota et al., and Nishizawa et al. teaches all the limitations of Claim 50 as set forth above in paragraph 19, except for a method

wherein the solid layer is a material selected from the group consisting of tungsten, tungsten nitride, tantalum nitride, titanium nitride, copper, aluminum, ruthenium oxide, iridium oxide, and silver. However, Gates et al. teach that such materials can be successfully deposited by using an ALD process (i.e., a process analogous to that of DiMeo, Jr. et al.) (Abstract, Col.4, lines 40 – 51, Col.5, lines 55 – 67, and Col.6, lines 1 – 57). It would have been obvious to one of ordinary skill in the art to utilize the deposition process of the combination of DiMeo, Jr. et al., Murota et al., and Nishizawa et al. to deposit the metal, metal oxide, and/or metal nitride layers taught by Gates et al. with the reasonable expectation of (1) success, as Gates et al. teach that such layers can be successfully deposited by an ALD process (i.e., a pulsed-precursor process, as taught by DiMeo, Jr. et al.) and (2) obtaining the benefits of using the process of the combination of DiMeo, Jr. et al., Murota et al., and Nishizawa et al., such as providing an additional activation means (i.e., UV light activation) for the process and reducing the deposition temperature.

22. Claims 52 – 55, 58, 61, 62, 66, 68, and 70 – 72 are rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Moore et al. (USPN 5,710,407).

23. Regarding independent Claim 52, DiMeo, Jr. et al. teach a process for forming layers in electronic devices (Col.1, line 14), the process comprising the steps of providing a reaction chamber, placing a substrate in the reaction chamber, pulsing a precursor fluid into the reaction chamber (Abstract and Figs. 1 – 3), exposing the

precursor fluid to light energy in the reaction chamber causing the precursor fluid to convert into a solid layer on the substrate (Cols. 8 – 10, especially Col.10, lines 53 – 64), wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid by purging the reaction chamber by flowing an inert gas through the reaction chamber (Figs. 2 – 3 and Cols. 9 – 10). DiMeo, Jr. et al. do not explicitly teach that the light energy is pulsed simultaneously with each pulse of precursor fluid. However, DiMeo, Jr. et al. do teach that the light activation is used in the deposition of the precursor layer and the oxidation of the precursor layer steps (i.e., when precursor gases are flowing) (Col.10, lines 53 – 64). DiMeo, Jr. et al. does not explicitly teach utilizing the light energy during, for example, the inert gas purging steps. Therefore, it would have been obvious to one of ordinary skill in the art to pulse the light energy of DiMeo, Jr. et al. in synchronization with (i.e., simultaneously with) each pulse of the precursor fluid with the reasonable expectation of successfully and advantageously aiding the deposition of the precursor layers, as desired and taught by DiMeo, Jr. et al., while beneficially reducing the total amount of light energy required to perform the process (i.e., by pulsing the light energy as opposed to continuously irradiating the light energy). By only pulsing the light energy during the precursor fluid pulsing step (i.e., not using the light energy during the inert gas purging steps), the amount of light energy is decreased (i.e., reduced to ~0) after each pulse of precursor fluid in the process of DiMeo, Jr. et al., as required by the applicant's claims. Further, Since UV light inherently gives off / provides some amount of thermal energy, the examiner

has reasonably interpreted the UV light of DiMeo, Jr. et al. to be a kind of “thermal light energy”, as required by the applicant’s claims. Additionally, DiMeo, Jr. et al. do not explicitly teach that the inert gas purging cools the solid layer. However, DiMeo Jr. et al. do suggest that the UV light energy is only utilized during the precursor pulsing steps and that an inert gas is flowed through the reaction chamber in between pulses of the precursor fluid (see the above discussion in this paragraph). As such, it is the examiner’s position that the lack of UV light energy and the flow of inert gas between precursor fluid pulses would have inherently provided at least some cooling of the deposited layer (i.e., due to the lack of UV-light as an additional energy source and the convection cooling of the deposited layer by the inert gas purge). Also, DiMeo, Jr. et al. do not explicitly teach that the reaction chamber is a “cold wall” chamber. Specifically, DiMeo, Jr. et al. are silent as to whether the chamber is a “hot wall” chamber or a “cold wall” chamber. Moore et al. teach a similar deposition method and apparatus to that of DiMeo, Jr. et al. (i.e., a deposition method and apparatus in which both heat and a radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25). Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would

detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of DiMeo, Jr. et al. with the reasonable expectation of successfully and advantageously preventing unwanted film deposition on the reaction chamber walls, thereby preventing unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

24. The combination of DiMeo, Jr. et al. and Moore et al. also teaches all the limitations of Claims 53 – 55, 58, 61, 62, 66, 68, and 70 – 72 as set forth above in paragraph 23 and below, including a method wherein:

- Claim 53 – The precursor fluid comprises a liquid vapor (Col.8, lines 22 – 47).
- Claim 54 – The precursor fluid comprises a gas (Col.8, lines 22 – 47).
- Claim 55 – The substrate comprises a semiconductor wafer (Col.11, lines 53 – 55).
- Claim 58 – The reaction chamber is maintained at a pressure less than atmospheric pressure when pulsing the precursor fluid into the reaction chamber (Col.10, lines 45 – 47).
- Claims 61 and 62 – The solid layer comprises a dielectric material or a conductive material. Specifically, DiMeo, Jr. et al. teach that the solid layer can be BST, PZT, or SBT, which are dielectric materials (see, for example,

Col.5, lines 53 – 60 of Kirlin et al. (USPN 6,320,213 B1)), or YBCO, which is a conductive material (see, for example, Col.4, lines 58 – 60 of Elmadjian et al. (USPN 6,420,251 B1)).

- Claim 66 – The solid layer comprises a material selected from the group consisting of zirconium oxide, aluminum oxide, a nitride, barium strontium titanate (BST), and a silicate (Col.7, line 26).
- Claim 68 – The chamber pressure is less than about 5 Torr when pulsing the precursor fluid into the reaction chamber (Col.10, lines 45 – 47).
- Claims 70 and 72 – The reaction chamber includes walls, the walls being made from an insulating material, specifically quartz (Col.11, lines 58 – 67 of Moore et al.).
- Claim 71 – The reaction chamber includes a cooling system for cooling the walls of the chamber (Col.5, lines 20 – 25 of Moore et al.).

25. Claim 57 is rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Moore et al. (USPN 5,710,407), and in further view of Murota et al. (USPN 5,705,224).

26. The combination of DiMeo, Jr. et al. and Moore et al. teaches all the limitations of Claim 57 as set forth above in paragraph 23, except for a process wherein the light energy is supplied by light energy sources positioned outside the reaction chamber. Specifically, DiMeo, Jr. et al. are silent as to the placement of the light sources. Murota et al. teach a similar photo-induced ALD process wherein the light sources

are positioned outside the reaction chamber (Figure 1 and Col.5, lines 1 – 5). It would have been obvious to one of ordinary skill in the art to position the light sources of DiMeo, Jr. et al. outside the reaction chamber as taught by Murota et al. with the reasonable expectation of successfully treating the layer with light energy as desired by DiMeo, Jr. et al. without contaminating the light sources by placing the light sources outside the deposition chamber as taught by Murota et al.

27. Claims 73 and 75 – 79 are rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Moore et al. (USPN 5,710,407), and in further view of Nishizawa et al. (USPN 5,443,033) and Thakur (USPN 5,863,327).

28. The combination of DiMeo, Jr. et al. and Moore et al. teaches all the limitations of Claim 73 and new independent Claim 75 as set forth above in paragraph 23, except for a process wherein, between selected pulses of the precursor fluid, the solid layer being formed is annealed (Claim 73), particularly a process wherein, between selected pulses of precursor fluid and after cooling, the solid layer is annealed by exposing the layer to thermal light energy prior to the next pulse (Claim 75).

Specifically, DiMeo, Jr. et al. are silent as to any annealing process and are silent as to the specific timing of the UV light exposure, except to say that the UV light energy is used as an additional activation means beyond thermal activation means in the process. Nishizawa et al. teach a similar process (i.e., a process in which both thermal and UV light energy are utilized during a pulsed-precursor deposition) and

teach that the UV-irradiation can be done either continuously or intermittently during the process of growth (Col.6, lines 22 – 28). In addition, DiMeo, Jr. et al. teach that their process is used to deposit a number of multi-component oxide films (Col.7, lines 8 – 38). Thakur teaches that it is desirable to anneal a film such as the ones deposited by DiMeo, Jr. et al. with UV radiation in order to increase the quality of the film and reduce the impurities in the film (Abstract and Col.5, lines 31 – 47 of Thakur). Therefore, it would have been obvious to one of ordinary skill in the art to anneal the solid layer of DiMeo, Jr. et al. by exposure to UV radiation in between pulses of the precursor fluid with the reasonable expectation of successfully and advantageously increasing the quality of the film by reducing the impurities in the film (i.e., due to the annealing). The UV light exposure between pulses of precursor fluid is equivalent to the applicant's claimed annealing step. By pulsing the UV light in synchronization with the precursor fluid pulses as well as in between the fluid pulses, one of ordinary skill in the art would have obtained the benefits of (1) activating the deposition process and (2) increasing the film quality while reducing the amount of energy necessary to perform the process (e.g., when compared to using a continuous UV light exposure). Further, Since UV light inherently gives off / provides some amount of thermal energy, the examiner has reasonably interpreted the UV light of DiMeo, Jr. et al. to be a kind of "thermal light energy", as required by the applicant's claims. Additionally, the combination of DiMeo, Jr. et al., Moore et al., Nishizawa et al., and Thakur does not explicitly teach that the UV light exposure (i.e., annealing) is performed after cooling. However, there are only three

possibilities for annealing the layer using pulsed UV light in between precursor fluid pulses: (1) anneal with UV prior to inert gas purging (i.e., cooling), (2) anneal with UV during inert gas purging, and (3) anneal with UV after inert gas purging. It would have been obvious to one of ordinary skill in the art to utilize any one of these three sequences of steps to perform the annealing process, including annealing after inert gas purging (i.e., cooling), with the reasonable expectation of success and obtaining similar results (i.e., annealing to successfully increase the quality of the film by reducing impurities in the film, regardless of the order in which the inert gas purging and annealing steps are carried out).

29. The combination of DiMeo, Jr. et al., Moore et al., Nishizawa et al., and Thakur also teaches all the limitations of Claims 76 – 79 as set forth above in paragraph 28 and below, including a method wherein / further comprising:

- Claim 76: Maintaining the reaction chamber at a pressure of less than about 5 torr when pulsing the precursor fluid into the reaction chamber (Col.10, lines 45 – 48).
- Claim 77: The reaction chamber includes walls, the walls being made from an insulating material (Col.11, lines 58 – 67 of Moore et al.).
- Claim 78: The reaction chamber includes a cooling system for cooling the walls of the chamber (Col.5, lines 20 – 25 of Moore et al.).
- Claim 79: The solid layer is annealed after each pulse of the precursor fluid. Specifically, it would have been obvious to one of ordinary skill in the art to anneal the solid layer of DiMeo, Jr. et al. by exposure to UV radiation in

between pulses of the precursor fluid for the reasons set forth above in paragraph 28. Further, it would have been obvious to one of ordinary skill in the art to anneal the solid layer after each pulse of precursor fluid (as opposed to only after some pulses), with the reasonable expectation of achieving the highest quality film possible due to minimizing the amount of impurities in the film by annealing after each and every precursor pulse deposition step.

30. Claims 52 – 55, 58, 61 – 68, and 70 – 72 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gates et al. (USPN 6,203,613 B1) in view of DiMeo, Jr. et al. (USPN 5,972,430), and in further view of Moore et al. (USPN 5,710,407).

31. Regarding independent Claim 52, Gates et al. teach a process for forming layers in electronic devices (Col.1, lines 5 – 20), the process comprising the steps of providing a reaction chamber, placing a substrate in the reaction chamber, pulsing a precursor fluid into the reaction chamber (Cols.5 – 6 and Examples 1 – 8), causing the precursor fluid to convert into a solid layer on the substrate (Examples 1 – 8), wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid by purging the reaction chamber with an inert gas (Col.6, lines 13 – 33, and Examples 1 – 8). Gates et al. also teach that this method is useful for depositing oxides and mixed oxide layers on a heated substrate (Col.7, lines 4 – 9, and Col.9, lines 20 – 44). Gates et al. do not explicitly teach exposing the precursor fluid to light energy in the reaction chamber to

cause the precursor to deposit onto the substrate. DiMeo, Jr. et al. teach a similar process of depositing the same category of mixed oxide layers onto a heated substrate using ALD. Specifically, DiMeo, Jr. et al. teach a process for forming layers in electronic devices (Col.1, line 14), the process comprising the steps of providing a reaction chamber, placing a substrate in the reaction chamber, pulsing a precursor fluid into the reaction chamber (Abstract and Figs. 1 – 3), exposing the precursor fluid to light energy in the reaction chamber causing the precursor fluid to convert into a solid layer on the substrate (Cols. 8 – 10, especially Col.10, lines 53 – 64), wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid by purging the reaction chamber by flowing an inert gas through the reaction chamber (Figs. 2 – 3 and Cols. 9 – 10). In other words, DiMeo, Jr. et al. teach that light energy can be used in addition to thermal energy to activate the deposition process (Col.10, lines 53 – 64). It would have been obvious to one of ordinary skill in the art to couple the light energy activation taught by DiMeo, Jr. et al. with the thermal energy activation deposition process of Gates et al. with the reasonable expectation of successfully depositing the films of Gates et al. with the benefit of an additional light activation means as taught by DiMeo, Jr. et al. (e.g., reducing the deposition temperature). The combination of Gates et al. and DiMeo, Jr. et al. does not explicitly teach that the light energy is pulsed simultaneously with each pulse of precursor fluid. However, DiMeo, Jr. et al. do teach that the light activation is used in the deposition of the precursor layer and the oxidation of the precursor layer steps (i.e., when precursor

gases are flowing) (Col.10, lines 53 – 64). DiMeo, Jr. et al. does not explicitly teach utilizing the light energy during, for example, the inert gas purging steps. Therefore, it would have been obvious to one of ordinary skill in the art to pulse the light energy of DiMeo, Jr. et al. in synchronization with (i.e., simultaneously with) each pulse of the precursor fluid in the deposition process of Gates et al. with the reasonable expectation of successfully and advantageously aiding the deposition of the precursor layers, as desired and taught by DiMeo, Jr. et al., while beneficially reducing the total amount of light energy required to perform the process (i.e., by pulsing the light energy as opposed to continuously irradiating the light energy). By only pulsing the light energy during the precursor fluid pulsing step (i.e., not using the light energy during the inert gas purging steps), the amount of light energy is decreased (i.e., reduced to ~0) after each pulse of precursor fluid in the process of the combination of Gates et al. and DiMeo, Jr. et al., as required by the applicant's claims. Further, Since UV light inherently gives off / provides some amount of thermal energy, the examiner has reasonably interpreted the UV light of DiMeo, Jr. et al. to be a kind of "thermal light energy", as required by the applicant's claims. Additionally, neither Gates et al. nor DiMeo, Jr. et al. explicitly teaches that the inert gas purging cools the solid layer. However, the aforementioned combination of references does suggest that the UV light energy is only utilized during the precursor pulsing steps and that an inert gas is flowed through the reaction chamber in between pulses of the precursor fluid (see the above discussion in this paragraph). As such, it is the examiner's position that the lack of UV light energy and the flow of

inert gas between precursor fluid pulses would have inherently provided at least some cooling of the deposited layer (i.e., due to the lack of UV-light as an additional energy source and the convection cooling of the deposited layer by the inert gas purge). Also, the combination of Gates et al. and DiMeo, Jr. et al. does not explicitly teach that the reaction chamber is a “cold wall” chamber. Specifically, Gates et al. and DiMeo, Jr. et al. are silent as to whether the chamber is a “hot wall” chamber or a “cold wall” chamber. Moore et al. teach a similar deposition method and apparatus (i.e., a deposition method and apparatus in which both heat and a radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25). Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of the combination of Gates et al. and DiMeo, Jr. et al. with the reasonable expectation of successfully and advantageously preventing

unwanted film deposition on the reaction chamber walls, thereby preventing unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

32. The combination of Gates et al., DiMeo, Jr. et al., and Moore et al. also teaches all the limitations of Claims 53 – 55, 58, 61 – 68, and 70 – 72 as set forth above in paragraph 31 and below, including a method wherein / further comprising:

- Claims 53 – 54 – The precursor fluid comprises either a liquid vapor or a gas (Col.6 of Gates et al.).
- Claim 55 – The substrate comprises a semiconductor wafer (Col.7, line 30 of Gates et al.).
- Claim 58 – The reaction chamber is maintained at less than atmospheric pressure. While Gates et al. is silent as to the deposition pressure, DiMeo, Jr. et al. teach that a suitable pressure for the deposition of mixed metal oxides as desired by Gates et al. is from about 0.02 to about 10 torr (i.e., less than atmospheric pressure). Therefore, it would have been obvious to one of ordinary skill in the art to choose a deposition pressure in this range with the reasonable expectation of successfully and advantageously using a pressure that is known in the art for use to deposit mixed metal oxides by vapor deposition, as desired by Gates et al. The exact pressure would be determined depending on the type of film being deposited and the precursors utilized.

- Claims 61 – 62 – The solid layer comprises a dielectric material or a conductive material (Col.2, lines 20 – 25, Col.4, lines 40 – 51, and Examples 1 – 8 of Gates et al.).
- Claim 63 – The solid layer comprises zirconium oxide (Example 1).
- Claim 64 – The precursor fluid comprises a hydride (Col.3, line 59).
- Claim 65 – The solid layer comprises a material selected from the group consisting of tungsten, tungsten nitride, tantalum nitride, titanium nitride, copper, aluminum, ruthenium oxide, iridium oxide, and silver (Example 5).
- Claim 66 - The solid layer comprises a material selected from the group consisting of zirconium oxide, aluminum oxide, a nitride, barium strontium titanate, and a silicate (Col.9, lines 15 – 50).
- Claim 67 – The solid layer comprises zirconium hafnium oxide (Example 3).
- Claim 68 – The reaction chamber is maintained at a pressure of less than about 5 torr (see discussion of Claim 58 above).
- Claims 70 and 72 – The reaction chamber includes walls, the walls being made from an insulating material, specifically quartz (Col.11, lines 58 – 67 of Moore et al.).
- Claim 71 – The reaction chamber includes a cooling system for cooling the walls of the chamber (Col.5, lines 20 – 25 of Moore et al.).

33. Claim 57 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gates et al. (USPN 6,203,613 B1) in view of DiMeo, Jr. et al. (USPN 5,972,430), in further view

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of Moore et al. (USPN 5,710,407), and in further view of Murota et al. (USPN 5,705,224).

34. The combination of Gates et al., DiMeo, Jr. et al., and Moore et al. teaches all the limitations of Claim 57 as set forth above in paragraph 31, except for a process wherein the light energy is supplied by light energy sources positioned outside the reaction chamber. Specifically, DiMeo, Jr. et al. are silent as to the placement of the light sources. Murota et al. teach a similar photo-induced ALD process wherein the light sources are positioned outside the reaction chamber (Figure 1 and Col.5, lines 1 – 5). It would have been obvious to one of ordinary skill in the art to position the light sources of DiMeo, Jr. et al. outside the reaction chamber as taught by Murota et al. with the reasonable expectation of successfully depositing / treating the layer with light energy as desired by DiMeo, Jr. et al. without contaminating the light sources by placing the light sources outside the deposition chamber as taught by Murota et al.

Response to Arguments

35. Applicant's arguments filed on 7/23/2003 have been fully considered but they are not persuasive. Specifically, the applicant broadly argues that none of the cited art discloses a process as claimed by the applicant in the currently amended independent claims, such as (1) a process in which a wafer is heated by a thermal heating device during pulsing of a precursor fluid, wherein after each pulse the processing chamber is purged with an inert gas, and wherein a layer is annealed

with thermal light energy multiple times during formation of the layer, (2) a process in which, after each pulse of precursor fluid, the amount of thermal light energy is decreased and the reaction chamber is purged with an inert gas that cools the solid layer, or (3) a process in which the solid layer is annealed by exposing the solid layer to thermal light energy prior to the next precursor pulse and after cooling. In response, the examiner has clearly shown in the statement / description of the rejections above that the various combinations of references do reasonably suggest performing the applicant's claimed process(es).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Both Ohta et al. (USPN 5,308,651) and Murayama et al. (USPN 4,678,536) teach using pulsed and/or continuous light sources to deposit various multiple-layer thin films in a vapor deposition process.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (703) 308-7557. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (703) 308-2333. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.


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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.


WDM

Wesley D Markham
Examiner
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SUPERVISORY PATENT EXAMINER
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